

Traumatic Brain Injuries Among Arizona Residents, 2007

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Executive Summary

Traumatic brain injuries were the cause of death for 1,374 Arizona residents in 2007. Males ages 85 years and older had the highest rate of TBI deaths with 164.9 deaths per 100,000 residents. TBI death rates were highest among American Indians (30.1 per 100,000 residents) and Non-Hispanic Whites (20.6 per 100,000 residents). Fifty percent of the TBI deaths in 2007 were due to unintentional injuries (n=683); 35 percent were due to suicides (n=475); and 12 percent were due to homicides (n=159). The most common causes of TBI deaths were firearms (44 percent, n=598), motor vehicle traffic-related injuries (21 percent, n=291), and falls (20 percent, n=268).

In 2007, there were 5,453 inpatient hospitalizations due to TBI in 2007. Adults 85 years and older had the highest rates of TBI inpatient hospitalizations. Males 85 years and older had a rate of 231.4 per 100,000 residents. The rate for females 85 years and older was 262.3 per 100,000 residents. TBI inpatient hospitalization rates were highest among American Indians (109.4 per 100,000 residents) and African Americans (92.9 per 100,000 residents). Unintentional injuries accounted for 87 percent of TBI hospitalizations (n=4,762) and assaults comprised an additional 12 percent (n=629). Motor vehicle traffic-related injuries were the most common cause of TBI hospitalizations (47 percent, n=2,552), followed by falls (27 percent, n=1,455).

In 2007, there were 33,677 TBI emergency department visits among Arizona residents. Almost half of TBI emergency department visits were among children ages 19 years and younger (47 percent, n=15,704). TBI emergency department visit rates were highest among children younger than one year of age. Females younger than one year of age had a rate of 1,651.6 visits per 100,000 residents, and males younger than one year of age had a rate of 1,810.5 visits per 100,000 residents. The majority of TBI emergency department visits were due to unintentional injuries (87 percent, n=29,462), and 12 percent were due to assaults (n=4,055). The leading causes of TBI emergency department visits were falls (45 percent, n=15,315), struck by/against injuries (24 percent, n=8,204), and motor vehicle traffic-related injuries (16 percent, n=5,463).

The data presented in this report show that TBI is a public health problem that impacts the lives of thousands of Arizona residents each year. The effects of TBI can include chronic pain, disability, large medical bills, changes in quality of life, and premature death. TBI can occur throughout the life span, and the repercussions of these injuries may be dealt with for many years. The consequences of TBI can extend beyond the injured individuals to their families and communities. With non-fatal TBI, family members are often required to provide care, which can result in time away from work, loss of income, and increases in stress. Within a community, the financial costs of TBI include medical expenses, rehabilitation, lost wages, and lost productivity. Most injuries are predictable and preventable. Understanding the causes of TBI is an important step towards educating and empowering communities and implementing prevention strategies.

Introduction

Traumatic brain injury (TBI) is defined as damage to the brain following a sudden blow to the head or by shaking the head violently. TBI can also be caused by a penetrating head injury that disrupts brain function. An estimated 1.4 million Americans sustain these injuries each year, and of these, 50,000 die as a result of the trauma. An additional 80,000 to 90,000 experience permanent disability, and it is estimated that 5.3 million Americans are currently living with a TBI-related disability.^{1,2} TBI can cause cognitive function deficits, which can lead to depression and other secondary outcomes including problems working and performing daily activities.

Figure 1. Traumatic Brain Injury Pyramid, Arizona 2007

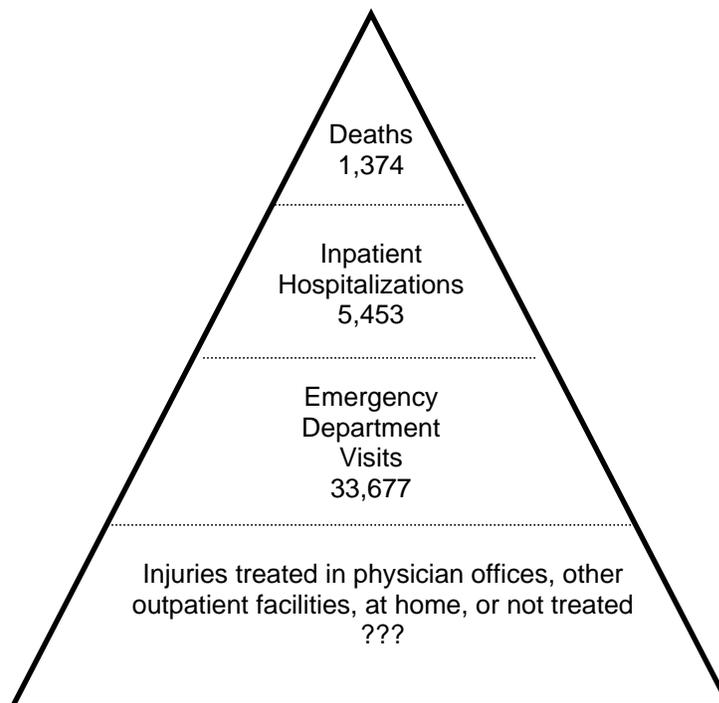


Figure 1 shows a TBI pyramid for Arizona in 2007. This pyramid shows that deaths represent the smallest proportion of injuries. The proportions increase towards the foundation of the pyramid, which is comprised of hospital discharges, emergency department visits, and self-care. Although TBI that do not require medical treatment may be the most numerous, no existing datasets capture these types of injuries.

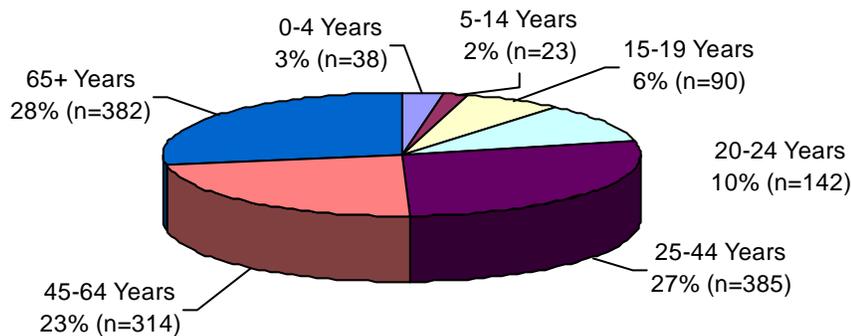
¹ Langlois JA, Rutland-Brown W, Thomas KE. *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths*. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2006

² Thurman D, Alverson C, Dunn K, Guerrero J, Sniezek J. Traumatic brain injury in the United States: a public health perspective. *Journal of Head Trauma Rehabilitation* 1999;14(6):602–15.

Deaths

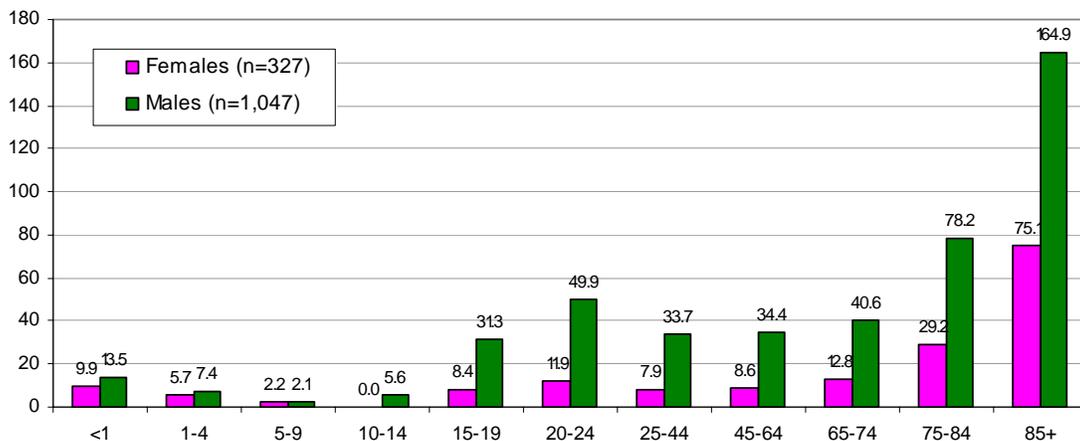
In 2007, 1,374 Arizona residents died as a result of TBI. The majority of deaths were among males (76 percent, n=1,047), while females accounted for 24 percent of TBI deaths (n=327). The largest number of deaths was among individuals ages 25 to 44 years (28 percent, n=385). Children ages 19 years and younger accounted for 11 percent of TBI deaths in 2007 (n=151). Age distributions are shown in Figure 2.

**Figure 2. TBI Deaths by Age Group, Arizona 2007
(n=1,374)**



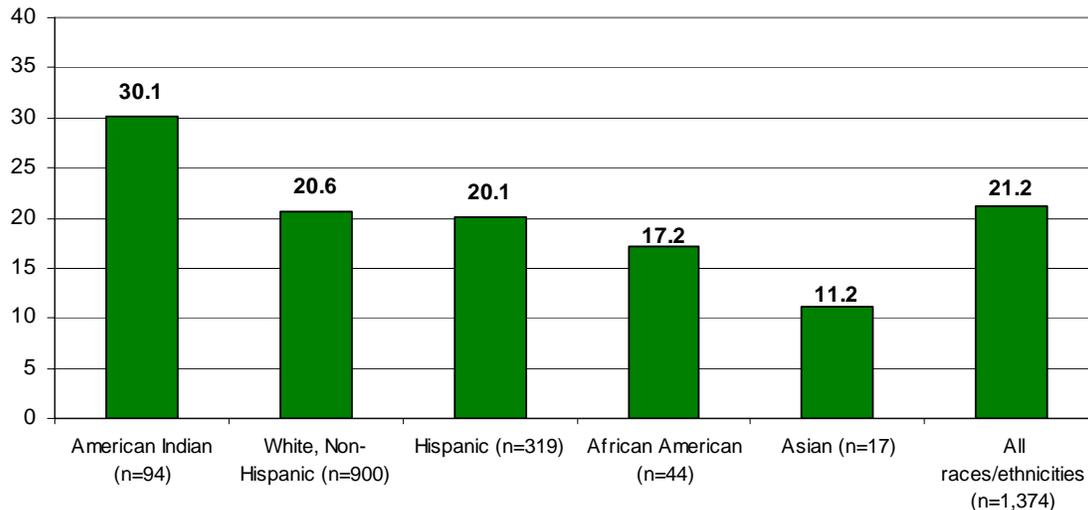
Males 85 years and older accounted for 67 deaths and had the highest rate of TBI deaths in 2007 (164.9 per 100,000 residents). For all adults 85 years and older, 71 percent of TBI deaths were due to unintentional falls (n=84). Figure 3 shows the 2007 TBI death rates by age group and sex for Arizona residents.

Figure 3. TBI Mortality Rates per 100,000 by Age Group and Sex, Arizona 2007



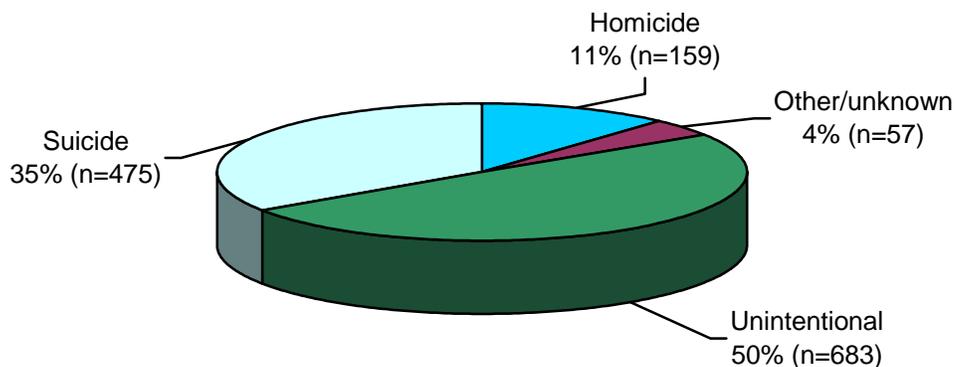
TBI death rates were highest among American Indians (30.1 per 100,000 residents) and Non-Hispanic Whites (20.6 per 100,000 residents). Figure 4 shows the 2007 age-adjusted TBI death rates by race/ethnicity in Arizona.

Figure 4. Age-Adjusted TBI Mortality Rates per 100,000 by Race/Ethnicity, Arizona 2007



Half of the TBI deaths in 2007 were due to unintentional injuries (50 percent, n=683); 35 percent were due to suicides (n=475); and 11 percent were due to homicides (n=159). Figure 5 shows TBI deaths by intent during 2007 in Arizona.

Figure 5. TBI Deaths by Intent, Arizona 2007 (n=1,374)



The most common causes of deaths were firearms (44 percent, n=598), motor vehicle traffic-related injuries (21 percent, n=291), and falls (20 percent, n=268). Causes of TBI deaths during 2007 in Arizona are shown in Table 1. Descriptions of these causes are given in Appendix A.

Table 1. TBI Deaths by Cause, Arizona 2007		
Cause	Number	Percentage
Firearm	598	44%
Motor vehicle traffic	291	21%
Fall	268	20%
Other/unspecified	155	11%
Other land transport	37	3%
Unknown cause	25	2%
Total	1,374	100%

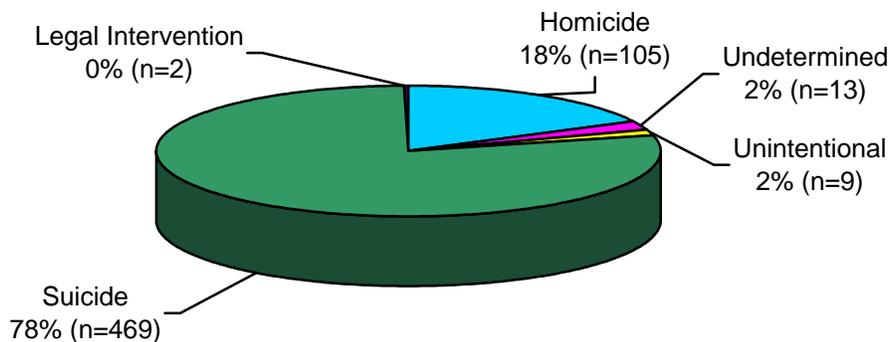
Firearms

Among the 598 Arizona residents who died as a result of firearm-related TBI, the majority were male (89 percent, n=531) and 11 percent were female (n=67). Seven percent of TBI deaths due to firearms were among children ages 19 years and younger (n=42). Fourteen percent of the deaths were among individuals ages 20 to 24 years (n=86); 62 percent were among individuals ages 25 to 64 years (n=371); and 17 percent were among individuals 65 years and older (n=99).

The highest rate of firearm-related TBI deaths was among White Non-Hispanics (n=424). This population had a rate of 10.4 deaths per 100,000 residents. The second highest rate was among Hispanics, who accounted for 137 deaths, or 7.8 per 100,000 residents.

The majority of firearm-related TBI deaths were suicides (78 percent, n=469). Eighteen percent of the deaths were due to homicides (n=105); 2 percent were of undetermined intent (n=13); and 2 percent were due to unintentional injuries (n=9). Two deaths were the result of legal intervention. Figure 6 shows TBI deaths due to firearms by intent.

Figure 6. TBI Deaths due to Firearms by Intent, Arizona 2007 (n=598)



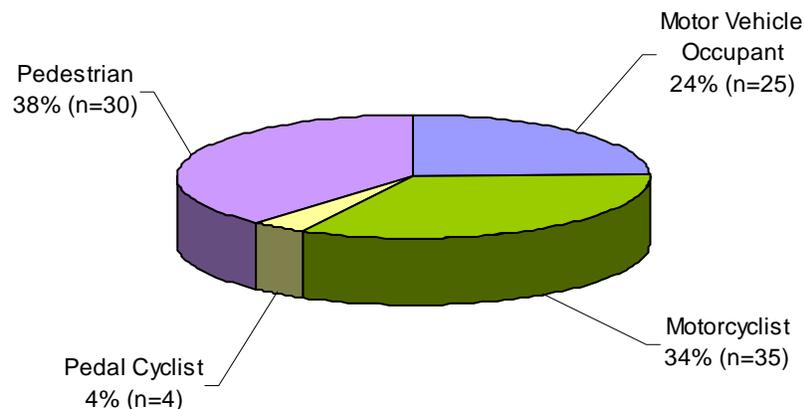
Motor Vehicle Traffic Crashes

Of the 291 TBI deaths due to motor vehicle traffic crashes, 70 percent were among males (n=204) and 30 percent were among females (n=87). All of the crashes were unintentional. Twenty-three percent of TBI deaths due to motor vehicle traffic crashes were among children ages 19 years and younger (n=66). Sixteen percent of the deaths were among adults ages 20 to 24 years (n=46); 52 percent were among individuals ages 25 to 64 years (n=151); and 10 percent were among adults 65 years and older (n=28).

The highest rate of motor vehicle traffic-related TBI deaths was among American Indians (13.2 per 100,000 residents; n=47). The second highest rate was among Hispanics, who accounted for 88 deaths, or 4.8 per 100,000 residents.

For most of the motor vehicle traffic-related TBI deaths, the location of the injured person was not specified on the death certificates (64 percent, n=187). Among the 104 deaths for which the location was specified, 38 percent of the deaths were pedestrians (n=30), and 34 percent were motorcyclists (n=35). Twenty-four percent of the deaths were occupants of motor vehicles at the time of the collisions (n=25). Pedal cyclists comprised 4 percent of the deaths (n=4). Figure 7 shows TBI deaths due to motor vehicle traffic crashes by injured person.

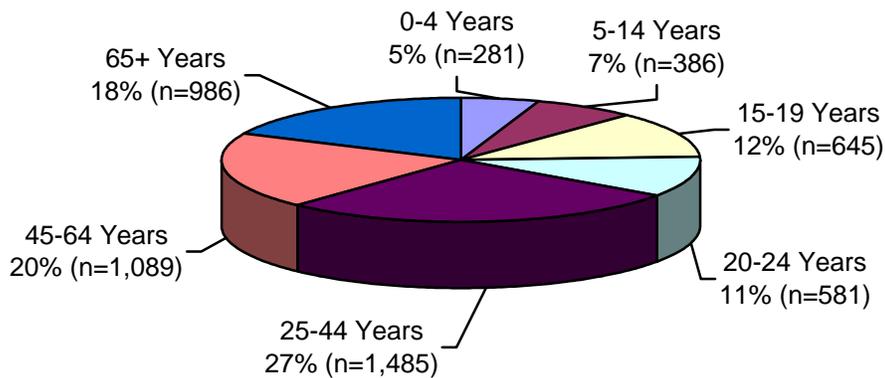
Figure 7. TBI Deaths due to Motor Vehicle Traffic Crashes by Injured Person, Arizona 2007 (n=104)



Non-Fatal Inpatient Hospitalizations

In 2007, 5,453 Arizona residents were hospitalized due to TBI. Males comprised 66 percent of total TBI hospitalizations (n=3,611) and females accounted for 34 percent (n=1,841). One hospitalization was of an individual of unknown sex. Twenty-four percent of TBI inpatient hospitalizations were among children ages 19 years and younger (n=1,312). The age distribution is shown in Figure 8.

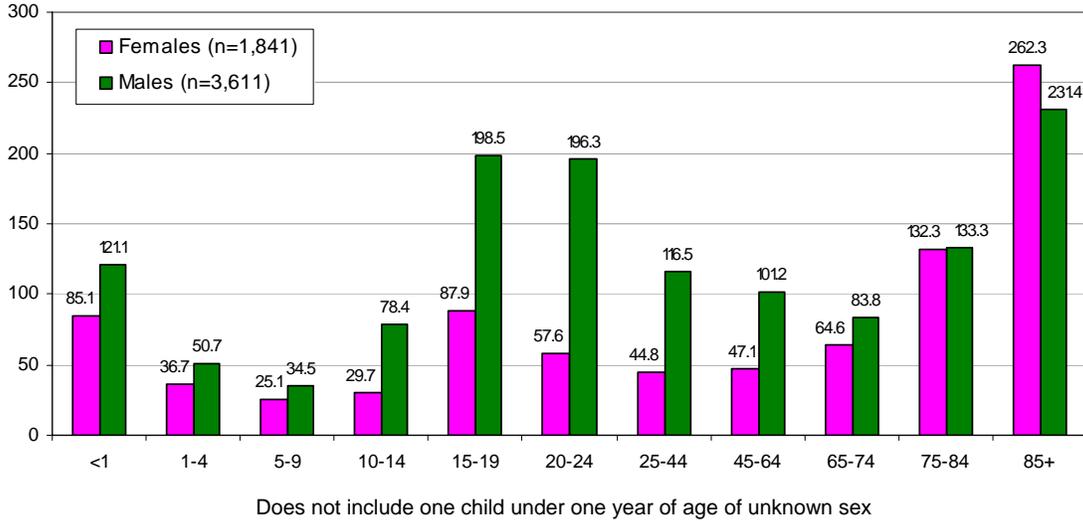
Figure 8. TBI Inpatient Hospitalizations by Age Group, Arizona 2007 (n=5,453)



Adults 85 years and older had the highest rates of TBI inpatient hospitalizations in 2007. Males 85 years and older had a rate of 231.4 per 100,000 residents (n=94), and the rate for females 85 years and older was 262.3 per 100,000 residents (n=178). For adults 85 years and older, 90 percent of hospitalizations were due to unintentional falls (n=244).

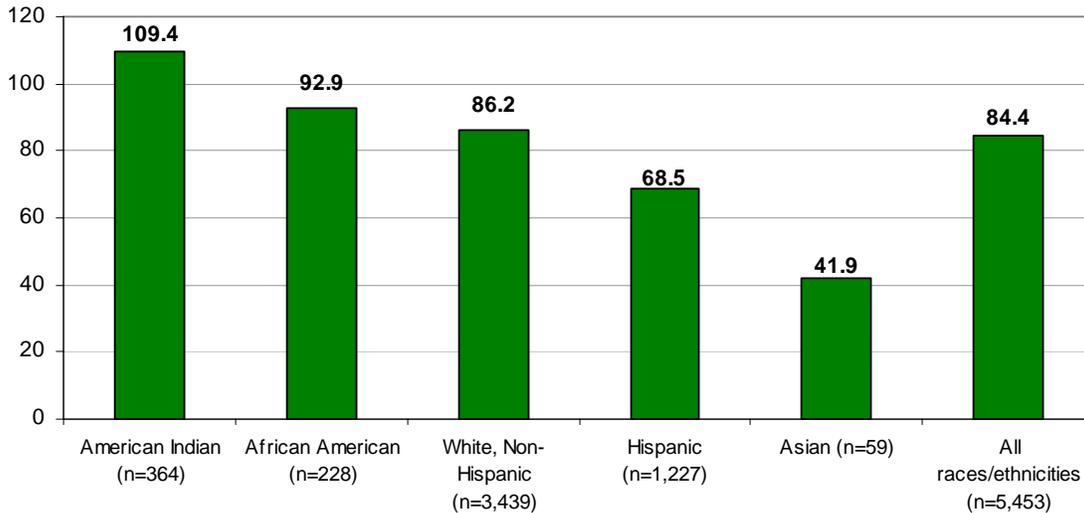
In contrast to the pattern observed with TBI deaths, the highest rates of TBI hospitalizations were among children younger than one year of age. For children younger than one year, 58 percent of hospitalizations were due to unintentional falls (n=62). Figure 9 shows the 2007 TBI inpatient hospitalization rates by age group and sex for Arizona residents.

Figure 9. TBI Inpatient Hospitalization Rates per 100,000 by Age Group and Sex, Arizona 2007



TBI inpatient hospitalization rates were highest among American Indians (109.4 per 100,000 residents) and African Americans (92.9 per 100,000 residents). Figure 10 shows the 2007 age-adjusted TBI inpatient hospitalization rates by race/ethnicity in Arizona.

Figure 10. Age-Adjusted TBI Inpatient Hospitalization Rates per 100,000 by Race/Ethnicity, Arizona 2007

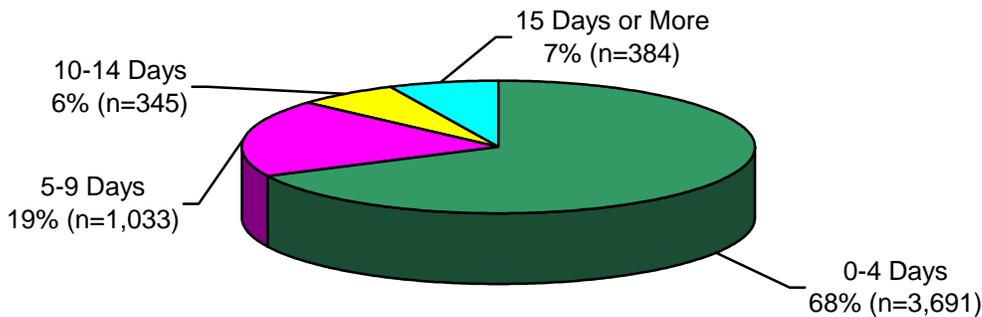


136 hospitalizations were other or unknown race/ethnicity

For TBI inpatient hospitalizations, the average length of stay was 5 days, with the majority of stays less than 5 days (68 percent, n=3,691). Length of stay in hospitals due

to TBI ranged from less than one full day to 104 days. Figure 11 shows TBI inpatient hospitalizations by length of stay.

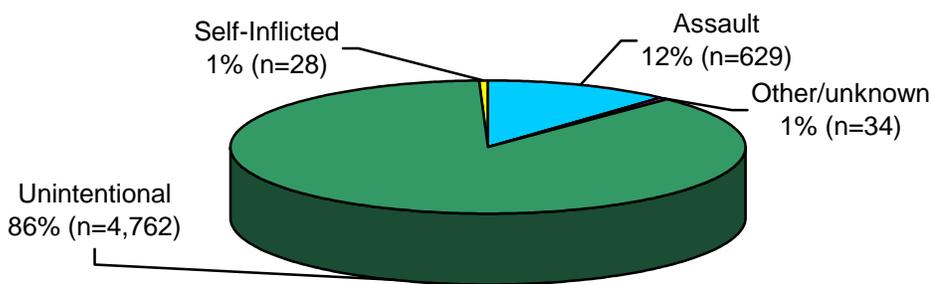
Figure 11. TBI Inpatient Hospitalizations by Length of Stay, Arizona 2007 (n=5,453)



TBI inpatient hospitalization-related charges in 2007 totaled more than \$314 million, with 44 percent paid by the Arizona Health Care Cost Containment System (AHCCCS)/Medicaid and Medicare. This total does not include costs related to physician care, rehabilitation, lost wages, or long-term costs of disability.

Unintentional injuries accounted for 86 percent of TBI hospitalizations (n=4,762). There were 28 self-inflicted TBI hospitalizations (1 percent) and 629 assaults (12 percent). Figure 12 shows the TBI inpatient hospitalizations by intent for Arizona in 2007.

Figure 12. TBI Inpatient Hospitalizations by Intent, Arizona 2007 (n=5,453)



Motor vehicle traffic-related injuries were the most common cause of TBI hospitalizations (47 percent, n=2,552), followed by falls (27 percent, n=1,455). Table 2 shows causes of TBI inpatient hospitalizations in Arizona during 2007. Descriptions of these causes are given in Appendix A.

Cause	Number	Percentage
Motor vehicle traffic	2,552	47%
Fall	1,455	27%
Struck by/against	578	11%
Other/unspecified	323	6%
Motor vehicle non-traffic	304	6%
Other pedal cycle	103	2%
Transport	75	1%
Firearm	63	1%
Total	5,453	100%

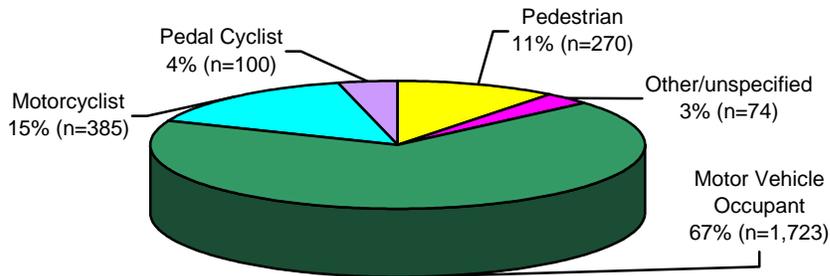
Motor Vehicle Traffic Crashes

Of the 2,552 TBI hospitalizations from motor vehicle traffic crashes, 65 percent were among males (n=1,647) and 35 percent were among females (n=904). One hospitalization was of an individual of unknown sex. Almost all of the crashes were unintentional (n=2,543). Twenty-six percent of TBI hospitalizations from motor vehicle traffic crashes were among children ages 19 years and younger (n=676); 14 percent were among individuals ages 20 to 24 years (n=355); 52 percent were among individuals 25 to 64 years (n=1,323); and 8 percent were among adults 65 years and older (n=198).

American Indians had the highest rate of TBI hospitalizations for motor vehicle traffic crashes (44.9 per 100,000 residents; n=153). With 41.6 hospitalizations per 100,000 residents, Non-Hispanic Whites had the second highest rate (n=1,562).

The majority of TBI inpatient hospitalizations due to motor vehicle traffic collisions were among occupants of motor vehicles (67 percent, n=1,723). Fifteen percent were motorcyclists (n=385); 11 percent were pedestrians (n=270); and 4 percent were pedal cyclists (n=100). Three percent were other/unspecified (n=74). Figure 13 shows TBI inpatient hospitalizations due to motor vehicle traffic crashes by injured person.

Figure 13. TBI Inpatient Hospitalizations due to Motor Vehicle Traffic Crashes by Injured Person (All Intents), Arizona 2007 (n=2,552)



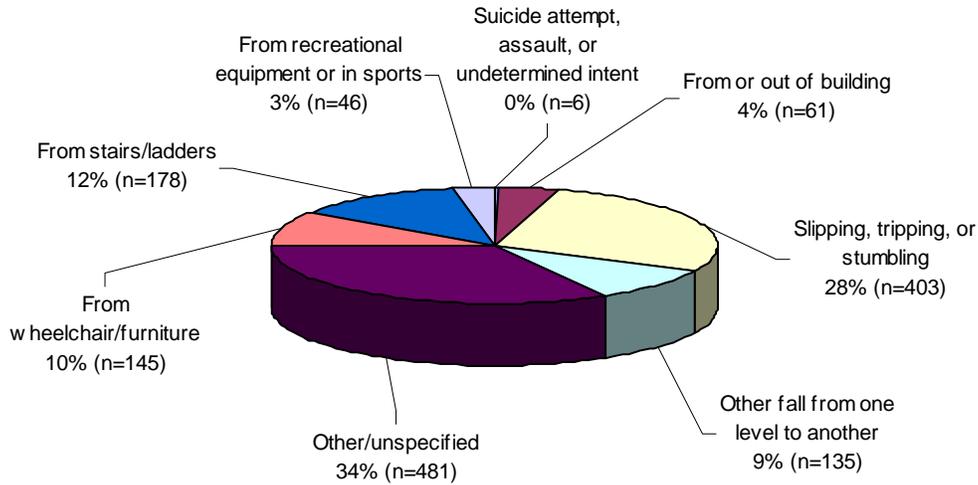
Falls

There were 1,455 inpatient hospitalizations due to fall-related TBI. Fifty-five percent were among males (n=802) and 45 percent were among females (n=653). Seventeen percent of the hospitalizations were among children ages 19 years and younger (n=248). Almost all of these falls were unintentional (n=1,449), but 6 were self-inflicted or from assaults or undetermined intents.

American Indians had the highest rate of fall-related TBI hospitalizations with 22.6 per 100,000 residents (n=64). The second highest rate was among Non-Hispanic Whites (22.0 per 100,000 residents; n=1,038).

In more than one third of fall-related hospitalizations, the hospital discharge database did not contain any specific information about the events contributing to these falls (34 percent, n=481). The most frequently specified contributing events were slipping, tripping, or stumbling (28 percent, n=403) and falls from stairs, steps, and ladders (12 percent, n=178). Figure 14 shows TBI inpatient hospitalizations due to falls by contributing event.

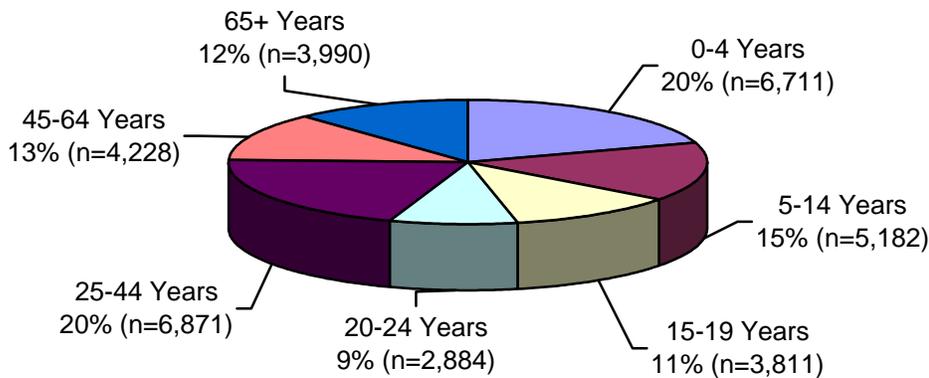
Figure 14. TBI Inpatient Hospitalizations due to Falls by Contributing Event (All Intents), Arizona 2007 (n=1,455)



Non-Fatal Emergency Department Visits

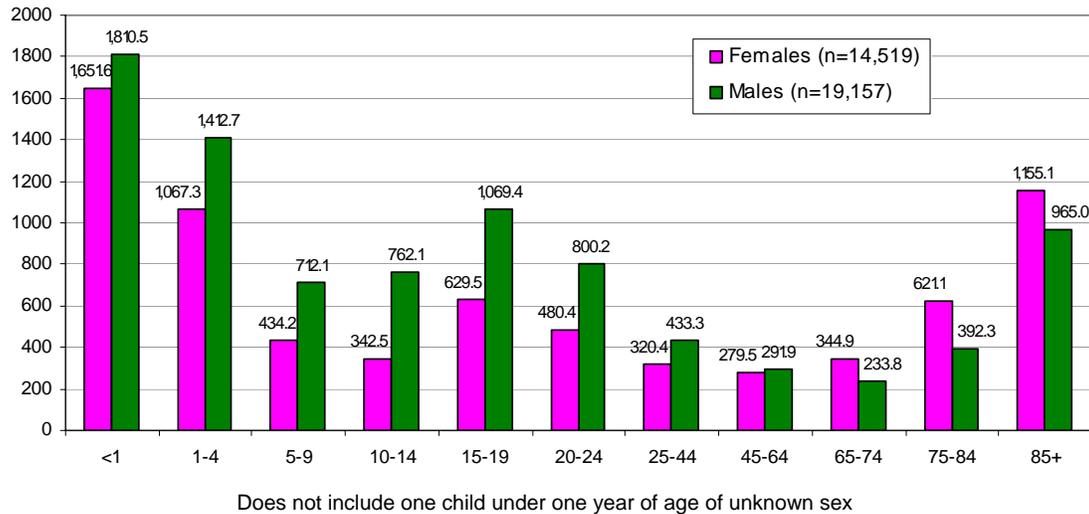
In 2007, there were 33,677 TBI emergency department visits among Arizona residents. Males accounted for more than half of TBI emergency department visits (57 percent, n=19,157), while females accounted for 43 percent of visits (n=14,519). One emergency department visit was by an individual of unknown sex. Forty-six percent of TBI emergency department visits were among children ages 19 years and younger (n=15,704). Emergency department visits by age group are shown in Figure 15.

Figure 15. TBI Emergency Department Visits by Age Group, Arizona 2007 (n=33,677)



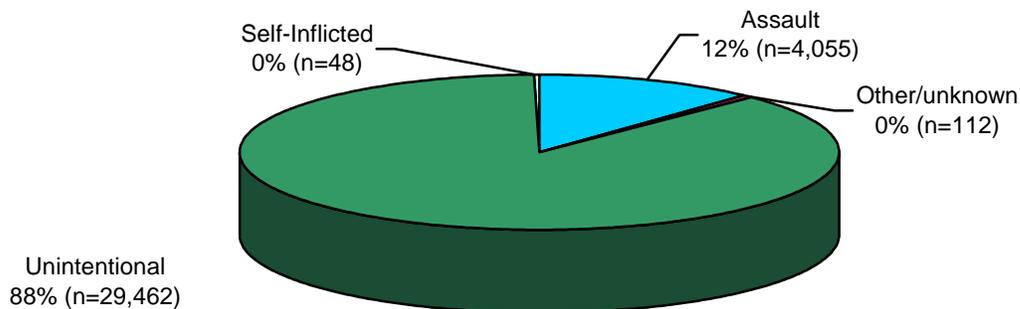
TBI emergency department visit rates were highest among children younger than one year of age. There were 835 emergency department visits among females younger than one year of age (a rate of 1,651.6 per 100,000 residents), and 942 visits among males younger than one year of age (a rate of 1,810.5 per 100,000 residents). For all children younger than one year of age, 85 percent of TBI emergency department visits were due to unintentional falls (n=1,509). For adults 85 years and older, 93 percent of visits were due to unintentional falls (n=1,088). Figure 16 shows the 2007 TBI emergency department visit rates per 100,000 Arizona residents.

Figure 16. TBI Emergency Department Visit Rates per 100,000 by Age Group and Sex, Arizona 2007



The majority of TBI emergency department visits were attributed to unintentional injuries (88 percent, n=29,462), and 12 percent were assaults (n=4,055). Figure 17 shows TBI emergency department visits by intent during 2007 in Arizona.

Figure 17. TBI Emergency Department Visits by Intent, Arizona 2007 (n=33,677)



The leading causes of TBI emergency department visits were falls (45 percent, n=15,315), struck by/against injuries (24 percent, n=8,204), and motor vehicle traffic-related injuries (16 percent, n=5,463). Table 3 shows TBI emergency department visits by cause for Arizona in 2007. Descriptions of these causes are given in Appendix A.

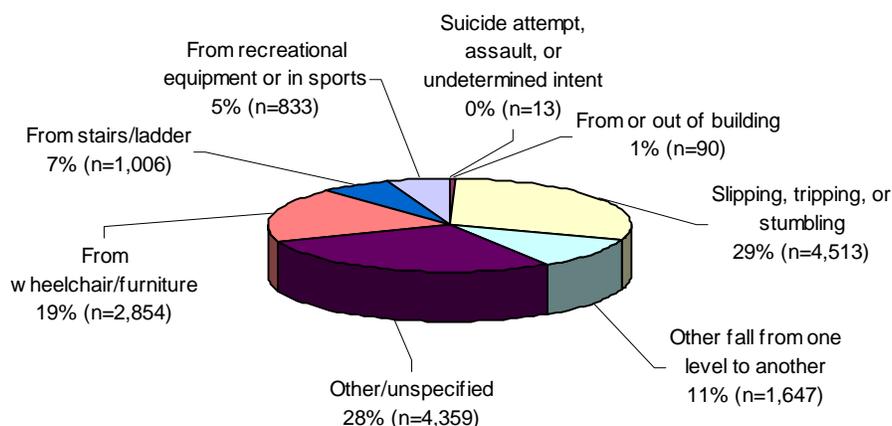
Cause	Number	Percentage
Fall	15,315	45%
Struck by/against	8,204	24%
Motor vehicle traffic	5,463	16%
Other/unspecified	2,550	8%
Motor vehicle non-traffic	958	3%
Other pedal cycle	878	3%
Transport	309	1%
Total	33,677	100%

Falls

There were 15,315 emergency department visits due to fall-related TBI. Forty-nine percent were among males (n=7,498) and 51 percent were among females (n=7,817). Nearly all of these falls were unintentional (n=15,302). Fifty-three percent of TBI emergency department visits due to falls were among individuals ages 19 years and younger (n=8,099).

Twenty-eight percent of the falls did not have contributing event information specified in the hospital discharge database (n=4,359). The most frequently specified contributing events to fall-related TBI were slipping, tripping, or stumbling (29 percent, n=4,513) and falls from furniture or wheelchairs (19 percent, n=2,854). Figure 18 shows TBI emergency department visits due to falls by contributing event.

Figure 18. TBI Emergency Department Visits due to Falls by Contributing Event (All Intents), Arizona 2007 (n=15,315)

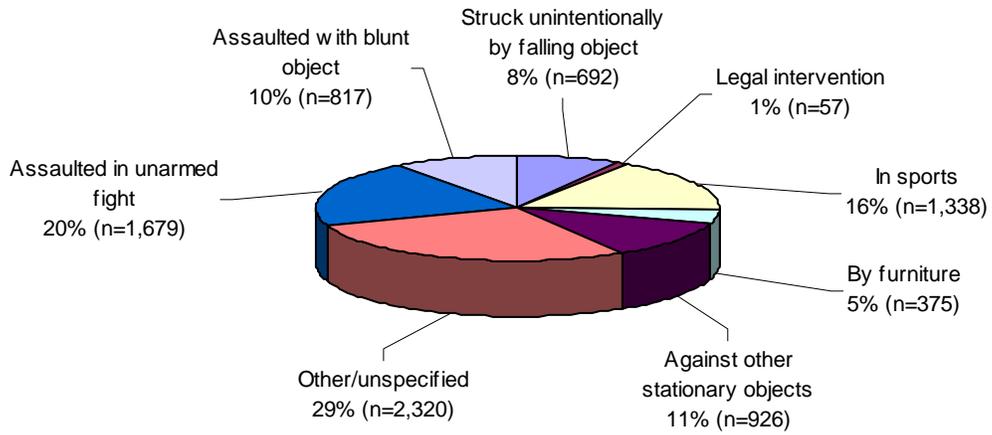


Struck By/Against Injuries

Struck by/against injuries include being struck by an object (such as falling furniture), striking against an object (such as the edge of a bathtub), or being struck by other people (such as when playing sports). Of the 8,204 TBI emergency department visits due to struck by/against injuries, 67 percent were among males (n=5,497) and 33 percent were among females (n=2,707). Sixty-nine percent of these injuries were unintentional (n=5,651), and 30 percent were assaults (n=2,496). Fifty-one percent of TBI emergency department visits from struck by/against injuries were among individuals ages 19 years and younger (n=4,190).

The emergency department discharge database did not include information regarding contributing event for 28 percent of the struck by/against injuries (n=2,320). The most frequently specified contributing events were assaults in unarmed fights (20 percent, n=1,679) and blows while playing sports (16 percent, n=1,338). Figure 19 shows TBI emergency department visits due to struck by/against injuries by contributing event.

Figure 19. TBI Emergency Department Visits due to Struck By/Against Injuries by Contributing Event (All Intents), Arizona 2007 (n=8,204)



Data Notes

All rates shown were calculated using the 2007 Arizona resident population estimates published by the Arizona Department of Health Services in *Arizona Health Status and Vital Statistics 2007*. Age-adjusted rates were standardized to the 2000 U.S. standard population.

Mortality data were tabulated from death certificates for Arizona residents who died in 2007. Inpatient hospitalization data were compiled from the 2007 Arizona Hospital Discharge Database. Emergency department visit data were compiled from the 2007 Arizona Emergency Department Discharge Database.

The discharge databases contain information from private, acute-care facilities in the state of Arizona, and do not include visits to federal facilities, such as Veterans' Affairs Hospitals or Indian Health Services facilities. The discharge databases do not contain data from urgent care facilities, private physician practices, or medical clinics.

Codes from the International Classification of Diseases, Version 9, clinical modification (ICD-9-CM) were used for determining TBI cases among hospital and emergency department data. ICD-10 codes were used for mortality data. The specific codes used are described in *Traumatic Brain Injury in the United States: Emergency Department Visits, Hospitalizations and Deaths*, published in 2006 by the U.S. Centers for Disease Control and Prevention (CDC).

Appendix A. Definitions of Causes	
Cause	Definition
Fall	Includes falls from furniture, stairs, playground equipment, and those that occur while playing sports.
Firearm	Includes injuries from handguns, shotguns, BB guns, etc.
Unknown cause	Cause not listed.
Motor vehicle traffic	Includes collisions that occur on public highways and streets. These collisions may include pedestrians, pedal cyclists, motorcyclists, and occupants of motor vehicles.
Motor vehicle non-traffic	Includes injuries from off-road vehicles. This cause only applies to hospitalization and emergency department databases and is not used on death certificates.
Other land transport	Includes collisions involving railway or all-terrain vehicles. This cause only applies to deaths and is not used in hospitalization or emergency department databases.
Other pedal cycle	Includes injured pedal cyclists struck by pedestrians, pedal cycles, or non-motorized vehicles.
Other/unspecified	Unspecified events or other rare events.
Struck by/against	Includes being struck by furniture, struck by other people while playing sports, or hit by objects while playing sports.
Transport	Other non-motorized vehicle transport. This cause only applies to hospitalization and emergency department databases and is not used on death certificates.